Lawns

COMMONWEALTH MYCOLOGICAL INSTITUTE
2 MAR 1956

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION, NEW HAVEN, CONNECTICUT

Circular 190 February, 1955

Cover photograph courtesy of
New York State College of Agriculture at Cornell University

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LAWNS

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Everybody is interested in lawns. The suburban householder with only a few hundred square feet of grass cover is as concerned that it be smooth and green as is the large estate owner who has many rolling acres of lawns. Increasingly, business buildings and factories, as well as public edifices, are surrounded by landscaped, lawn-covered areas.

The Connecticut Experiment Station is also interested in lawns. Since 1886 when it started a "grass garden" at Manchester to compare the usefulness for the region of various species of grasses, it has carried on studies of how lawns grow, and how to make them grow greener.

The material which follows gives the results of the Station's experiments and experiences on the establishment and maintenance of lawns. Believing that the lawn owner is interested in the reasons for certain procedures and can care for his lawn more intelligently if he knows them, the authors have attempted to give the "hows" and "whys" behind each cultural or control method discussed.

This circular supersedes Circular 169, "How Good Lawns Grow", which is now out of print. It contains all the information given in Circular 169, plus new material based on the Station's experimental work in this field since Circular 169 was last revised in 1952.

SOIL CONDITIONS

Good lawns require good soil. At least six inches of loam, well supplied with organic matter, with the underlying substratum of approximately the same texture is ideal. The soil should be well-drained. Sand, gravel, hard pan, or bed rock should not be closer than 20 inches to the surface.

Unfortunately, the average Connecticut resident is not apt to have these ideal soil conditions. The natural soils of the State are of many textures, ranging from coarse sands and gravels to clays. Further, the natural soil may be badly mixed up and may contain broken bricks, sticks, stones, sod, and other miscellany of doubtful value as growing media. Thus, the home owner may have no choice but to make the best of what he has.

Coarse-textured soils (loamy sands and coarser) are droughty and do not hold fertilizer nutrients well. Such soils will require either a thick covering of good loam, or the incorporation of large amounts of organic matter.

Fine-textured soils like the clay loams and clays may be poorly drained, favoring disease and sometimes killing the grass through the presence of standing water. Installation of drain tile and/or intercepting

[1,2,3] Soils, Plant Pathology, and Entomology departments, respectively.

drains, and the incorporation of sandy material and organic matter are the usual remedies.

Spreading coarse-textured topsoil[1] on a clayey subsoil does not solve the problem, because the unsatisfactory conditions cited above still exist. A clayey topsoil on sand is equally bad because of the droughty character of the subsoil and the slow passage of water through the clay. The real remedy in either case is to mix the coarse and the fine textured materials to a sufficient depth to provide enough room for grass to root with perhaps 6 inches to spare.

MAKING A NEW LAWN

Time of Year

September is the best time to start a lawn. Annual weeds offer less competition at this time than they do in the spring and the young grass has more time to develop and become resistant to the heat and dry weather of the following midsummer. Seeding in October is less desirable but under average conditions is preferable to waiting until spring.

If it is necessary to seed in the spring, it should be done in early April, or even in March, if the season is favorable and the seed bed can be put into good condition.

Preparation of the Soil

The best time to improve the soil is when the ground is being prepared for seeding. The basic grading should be made on the subsoil so that the topsoil, when applied, will be of uniform thickness in all parts of the area. Six inches of good loam topsoil, well supplied with organic matter, is ideal for growing grass.

In those cases where the topsoil is already in place but is thin or very sandy or otherwise unsuitable, it can be covered with from 2 to 6 inches of topsoil if the grade will permit (i.e., if the level of the soil can be raised that much).

"Loam" is a term commonly applied to topsoil by the layman. Such soil may be no better or even poorer than the soil the homeowner already has. Good loam contains, roughly, 18 per cent clay, 40 per cent silt, and not more than 52 per cent sand. It is fairly high in organic matter. Generally speaking, a dark color indicates adequate organic matter but that is not always the case. If there is doubt about the quality, a *representative* sample of the "loam" can be examined and tested by a soil testing laboratory *before* the purchase is made. Good loam is expensive, but in the long run it is cheaper than the maintenance and reseeding costs likely to be incurred as a result of using low quality topsoil.

[1] Topsoil in this circular is used to indicate the surface 3 to 8 inches of soil usually rich in organic matter, dark brown, dark gray, or black in color, and presumed to be moderate to high in fertility, depending on the past management of the soil. It is the area of maximum root growth of plants. It is also a general term used to refer to soil used for topdressing lawns, gardens, road banks, and parks. Good topsoil is generally taken from previously well managed farmed land of loam texture, rich in organic matter.

In those situations where the addition of loam topsoil is not feasible, the existing soil can be improved by adding organic matter. Any of the materials in Table 1, when worked into the soil to a depth of 3 or 4 inches, give good results. A mixture of two, say peat and manure, is better than either one used alone.

TABLE 1. BENEFICIAL ORGANIC MATERIALS FOR IMPROVING THE PHYSICAL CONDITION OF SOILS

Material	Amount per 1000 sq. ft.
Stable manure, rotted for several months to destroy weed seeds	½ cord (2½ cu. yds.[1])
Granulated peat moss	4 bales
Native moist peat, peat humus or swamp muck	2 to 3 cu. yds.
Digested sewage sludge[2]	1 to 2 cu. yds.

[1] One cu. yd. equals 21.7 bushels.

[2] Not to be confused with activated sludges sold as commercial fertilizer, which should not be used in large quantities.

The Experiment Station has conducted many experiments with chemical soil conditioners since their appearance on the market a few years ago. In general, their use in place of organic materials for improving the structure of lawn soils has not given satisfactory results. Instances where they are helpful are mentioned on p. 9.

Soil Sampling and Testing

If the acidity and fertility level of the soil are not known, a soil test may be made to determine the lime and fertilizer needs of the lawn area. This should be done considerably in advance of seeding so that the findings will be available in ample time. The soil sample is obtained by taking small quantities of soil to a depth of 2 to 3 inches from 12 to 15 points well scattered over the area. The soil from these points should be thoroughly mixed together (after air-drying if wet) and about a pint of the mixture packed in a clean carton, box, or bag not previously used for drugs, chemicals, or other contaminating substances. Ice cream cartons are satisfactory soil sample containers. Soil areas which are obviously different should be sampled separately. Since the test results are dependent on the soil sample, it is very important that the sample be representative of the area. A description of the treatments made to the land in the past should be included with the sample. Places where soils may be sent for testing include this Station, P. O. Box 1106, New Haven; its Tobacco Laboratory, P. O. Box 348, Windsor; and the Department of Plant Science, University of Connecticut, Storrs.

Lime and Fertilizer

A moderate degree of soil acidity is not harmful to turf grasses adapted to this region. In fact, it appears to help check the invasion of numerous weed species such as dandelion, plantain, and chickweed. However, high acidity as indicated by pH tests below 5.0 will eventually

reduce the vigor of turf grasses, especially Kentucky blue grass, and lime is necessary to counteract this effect. Under average conditions, strongly acid soils will require about 100 pounds of ground limestone per 1000 square feet. This should be well worked into the soil as one step in the preparation for seeding.

If fertilizer is needed, and it usually is, it can be supplied by one or more of the materials listed in Table 2. It is very important to apply sufficient fertilizer and work it well into the soil before seeding. Fertilizers of similar grade, such as 5-10-5 and 5-8-7, are sufficiently similar in composition that they may be used interchangeably, depending on their availability on the market.

Factory-mixed, complete fertilizers can usually be purchased in stores handling lawn, garden or farm supplies. Although many mixtures are sold under a trade name, every bag is required by law to show the analysis in per cent of nitrogen, phosphoric acid and potash. A 5-10-5 fertilizer, for example, contains 5 per cent nitrogen, 10 per cent phosphoric acid and 5 per cent potash as seen in Table 2. Purchase should always be made on the basis of the analysis.

In preparing the soil for lawn grass seeding, it is well to supplement factory-mixed complete fertilizers with one of the organic nitrogen materials. Such fertilizer releases its nitrogen slowly and thus is beneficial over a longer period of time.

TABLE 2. COMMON LAWN FERTILIZERS

Fertilizers	Analysis			Rate of application per 1000 sq. ft.	
	Nitrogen %	Phosphoric acid %	Potash %	For new lawns[1] lbs.	Top-dressing of established lawns lbs.
Complete factory-mixed fertilizers					
5-10-5	5	10	5	30	20
5-8-7	5	8	7	30	20
7-7-7	7	7	7	20	15
8-6-2	8	6	2	...	12
8-6-4	8	6	4	...	12
10-5-5	10	5	5	...	10
10-6-4	10	6	4	...	10
Organic, chiefly sources of nitrogen					
Castor pomace	5	2	1	70	35
Cottonseed meal	6.5	3	2	60	30
Commercial activated sewage sludge	6	2	1	60	30
Dried cow manure	2	1	1	150	75
Dried sheep manure	1.5	1.5	2	200	100
Dried poultry manure	2.5	2	1	100	50
Inorganic sources of nitrogen[2]					
Nitrate of soda	16	0	0	...	5
Sulfate of ammonia	20.5	0	0	...	4
Uramon	42	0	0	...	2
Ammonium nitrate	33	0	0	...	2
Calcium nitrate	15	0	0	...	5

[1] To be worked into the soil prior to seeding.
[2] See page 13 for method of application of soluble fertilizers.

Under average soil conditions for new seeding, either of the following mixtures should give good results:

Mixture A	*Lbs. per 1000 sq. ft.*	*Mixture B*	*Lbs. per 1000 sq. ft.*
5-10-5 fertilizer	20	5-10-5 fertilizer	20
Castor pomace or activated sewage sludge	10	Dried cow or sheep manure	30

If stable manure or digested sewage sludge[1] was used to supply organic matter as outlined in the section on "Preparation of the Soil", the amount of fertilizer applied before seeding should be cut in half. The quantities given in Table 2 should be reduced if more than one of the materials are applied simultaneously.

A hand wheel cultivator is a useful tool for incorporating the lime and fertilizer. Rake and roll the soil to a final grade with a firm, smooth surface before the seed is sown. If the ground is rototilled instead of plowed, it may be necessary to wait until after a rain or after thorough watering in order to settle the soil. Before working it down, the soil should be dry enough so that it does not stick to garden tools.

Seeding

Uniform distribution of the seed is essential, whether done by hand or with a mechanical seeder. It is advisable to divide the seed into two lots, applying one lot while traversing the area lengthwise, and the other lot while going crosswise. The seed should be lightly covered by scratching the surface with an iron rake or the back side of a leaf raker, followed by a light rolling. Never roll when the soil is wet. Unless the soil is kept moist by rains, it should be sprinkled thoroughly when necessary to facilitate seed germination.

Slopes which tend to wash can be mulched with coarse hay or covered with tobacco cloth or old burlap after seeding. Fine organic materials such as lawn clippings tend to smother young seedlings. A new method of erosion control is to stabilize the soil by applying a chemical soil conditioner before seeding. One pound of 100 per cent active chemical or 4 pounds of 25 per cent material per 100 square feet have given good results. The conditioner should be thoroughly worked into dry soil by raking or harrowing to a 3-inch depth. Surface application of conditioner generally will give disappointing results because the conditioner chemical does not leach or move down into the soil.

Conditioners cause the soil surface to dry out more quickly than it otherwise would, hence the newly seeded lawn should be watered frequently to keep the soil surface moist.

Conditioners will improve the structure or tilth of some soils, especially those high in clay. They prevent the latter from slaking and becoming an impervious mass. They are in no sense fertilizers and will not replace the nutrient qualities of organic matter. Their use increases

[1] See footnote 2, Table 1.

the porosity of many soils, making them easier to work, and reduces cracking and crusting of the soil surface.

Lawn Seed Mixtures

Seeding mixtures for lawns are composed of two general types of grasses: permanent and temporary. Permanent grasses are slow germinating and slow growing; temporary grasses are quick sprouting and short-lived. The many strains of bentgrasses, the bluegrasses, and the fescues, except meadow fescue, are permanent grasses and become the chief components of established lawns. The seed is usually expensive. Temporary grasses are known as nurse crops because they come up quickly, provide green cover and keep the soil from eroding while the slower growing grasses are getting established. Rye grasses, red top and timothy are in the nurse crop class.

All "lawn seed" mixtures must, by State law, contain a required minimum percentage of permanent grasses, with a limit as to the amount of inert matter and weed seed present. There is no such requirement for mixtures labelled "grass seed". However, the law requires that every package of either kind of seed be labelled to show the percentage by weight of all component parts, including weed seeds and inert matter such as dirt and plant parts. The careful buyer will examine the label on the package before buying to determine if the contents fit the purpose he has in mind.

Bentgrasses alone are not desirable for the home lawn because they are very susceptible to several lawn diseases and require constant care with close and frequent mowing and high fertilization.

Low-priced mixtures containing appreciable amounts of timothy and other pasture grasses are either short-lived or will not stand close cutting. These mixtures are suitable only for seeding down a vacant lot or similar piece of land which needs cover but is not to be maintained as a lawn. It is very poor economy to use such mixtures in the preparation of a permanent lawn.

Suggested seeding mixtures and rates for various conditions are given in Table 3. If clover is desired, white Dutch clover seed should be added at the rate of 1 ounce per 5 pounds of seed mixture. For best results, the soil should not be too acid. It is often necessary to lime the soil to insure good growth of clover. Clover seed should be sown in the early spring. Fall seedings are risky because of possible winter kill.

New Grasses

Zoysia. Meyer zoysia is a strain of *Zoysia japonica,* Japanese lawngrass that has recently been well advertised for lawn use. Meyer zoysia will grow well in the sun and light shade. It is heat and drought tolerant, gives good competition to weeds and will stand heavy usage. Its chief drawback is that it turns brown with the first heavy frost in the fall and remains brown all winter, turning green only in May. Meyer

zoysia somewhat resembles Kentucky bluegrass in appearance. It is commonly propagated by plugs or strips which may be inserted into an existing lawn or planted on newly turned earth. Two-inch plugs on twelve-inch centers will form thick turf in two years.

TABLE 3. SEEDINGS FOR VARIOUS CONDITIONS

Formula	Percentage of mixture, by weight	Lbs. of mixture per 1,000 sq. ft.
1. Blue grass, suitable for average lawn and park conditions		
Kentucky blue grass	80	3
Red top or Domestic rye grass	20	
2. Mixed grasses, for variable soils under average lawn conditions		
Kentucky blue grass	60	3
Astoria or Colonial bent	20	
Red top or Domestic rye grass	20	
3. Fescue, for sandy soils, dry shady locations and much used areas		
Chewings fescue	80	3
Red top or Domestic rye grass	20	
4. Rough blue grass, for moist, heavily shaded areas		
Rough blue grass	80	3
Red top or Domestic rye grass	20	
5. Mixed grasses, for variable shade conditions		
Kentucky blue grass	40	3
Rough blue grass	40	
Red top or Domestic rye grass	20	
6. Mixed grasses, for steep slopes and elsewhere where rapid soil coverage is desired		
Kentucky blue grass	5	3
Chewings fescue	50	
Creeping red fescue	20	
Colonial bent	5	
Domestic rye grass	20	

Attempts to grow the usual lawn grasses along with zoysia in expectation of having a green lawn the entire season are apt to prove disappointing. Such a mixture results in the lawn having a ragged appearance from fall until spring.

Merion bluegrass. Merion bluegrass is a strain of Kentucky bluegrass that is said to be drought tolerant and more resistant to leaf spot than ordinary Kentucky bluegrass. Merion is slow in getting established but is superior in color and texture. It is also higher in price. Merion will not keep out clover or crabgrass. It is susceptible to lawn rot, a fungus disease common in Connecticut. Some reports say to mow Merion bluegrass with a short ¾ inch cut, but 1 to 1½ inches appears to be better. With a longer cut, it is not necessary to water the lawn so often and it is less likely to contract various fungus diseases.

LAWN MAINTENANCE

Spring Renovation

After the customary raking to remove dead leaves and the usual accumulations of over-winter rubbish, depressions should be smoothed with screened loam, the spring topdressing of fertilizer applied, and bare patches reseeded. Rolling is usually required to eliminate roughness due to frost heaving, moles or other causes. This is best done while the soil is still moist, but not so wet as to show a film of water on the surface when passed over by the roller.

Lime and Fertilizer Program

Fifty pounds of ground limestone (or 40 pounds of hydrated lime) per 1,000 square feet every four or five years is usually sufficient to maintain the proper degree of soil reaction. Very light applications annually do no harm but are an unnecessary expenditure of labor. Overliming should be avoided. Lime can be applied at any time of the year, and while it will not burn the grass if carelessly applied, it should be applied evenly to be fully effective.

When treating an established lawn, lime should not be applied simultaneously with fertilizer for they will react chemically, causing a loss of nitrogen in the form of ammonia gas. In general, it is better to apply the fertilizer first, and not put on the lime until after a good rain or a thorough watering.

Most lawns need fertilizer at least once a year, and they will do better if given two applications, — one in the spring and one in the fall, preferably in September. If the grass lacks good green color early in the summer, it may be given a nitrogen fertilizer at that time. Materials and amounts for topdressing an established lawn are shown in the last column of Table 2.

Most of the plant food in factory-mixed complete garden or farm fertilizers is in concentrated mineral form and is quickly soluble; thus, these fertilizers must be applied evenly and when the grass is dry. Careless and uneven spreading will "burn" the grass and may kill it. When properly applied, no injury will result and it is not necessary to hose or sprinkle the grass afterward, although if there is any question about the character of the spreading job, it is well to water the lawn thoroughly. The ideal time to fertilize is just before a good rain. Overfertilization should be avoided.

Organic fertilizers such as castor pomace, cow manure, and commercial activated sewage sludge, can be applied freely with little or no danger of burning, but using more than is necessary is wasteful and costly. The plant nutrients in these fertilizers are considerably more expensive per pound but their slow breakdown and release of soluble nutrients frequently justifies the extra cost. Generally, factory-mixed fertilizers which contain organic sources of nitrogen are better than those containing only inorganic nitrogen for the same reasons.

All fertilizers, whether organic or not, should be distributed evenly. One method is to divide the total amount of fertilizer to be used on a

given section of lawn into two lots. Spread one batch lengthwise of the area and the second batch crosswise. A small fertilizer distributor is very convenient for this work. However, one must be sure it spreads evenly and doesn't drop fertilizer in piles on the turns and ends. If uncertain as to the performance of the distributor, it is better to do it by hand. Special caution is needed with some of the newer free-flowing fertilizers.

Nitrogenous fertilizers containing more than 10 per cent of nitrogen, such as sulfate of ammonia, nitrate of soda, or uramon, should be mixed with sifted loam before spreading, or they may be dissolved in water and sprinkled on the turf, followed by liberal watering. They may be used as topdressing for spring or fall treatments on well established turf if soil tests show sufficient phosphate and potash present. These nitrogenous fertilizers can be used with a proportioner as described in the following paragraph.

Soluble complete fertilizers are becoming increasingly available on the market. If used, apply not more than five pounds per 1000 square feet of material containing 20 per cent nitrogen in the spring (preferably in 3 or 4 doses) and one-half that amount in early September. Reduce the amount proportionately if the material contains more than 20 per cent nitrogen. All applications should be made in solution. This can best be done with a proportioner of which there are several on the market. A proportioner consists of a garden hose attachment provided with a side tube that sucks the concentrated solution into the hose and dilutes it while watering the lawn. Proportioners can also be used to apply nitrogen solutions, weed killers, insecticides, and fungicides.

Fully soluble fertilizers must of necessity be applied in light doses, and in order to furnish the necessary amount of plant food for rapidly growing grass, must be used at frequent intervals.

Mowing

Very close mowing reduces the vigor of the turf, especially when practiced in early spring. Blue grass is injured by short clipping. The first mowing in the spring should be deferred until the grass is 2½ inches high. The mower should be set to cut at approximately 1½ inches throughout the season. If mowing is done regularly before the grass exceeds 2½ inches in height, the clippings may well be left on the lawn, thus adding some organic matter to the soil. Where the grass has been allowed to get taller than 2½ inches, the mowings should be raked off or caught in a grass catcher.

New grass also should be mowed when it reaches 2½ inches. A sharp mower is a necessity for all lawn work and especially for new grass.

Watering

Many lawns, especially when situated on light sandy or thin soils, suffer severely from lack of moisture during hot dry periods in summer. Sprinkling with the ordinary hose, nozzle held in the hands, is laborious and rarely effective. Much of the water may run off without soaking in, and the temptation is to water every day or so, without doing

much more than wetting the grass leaves at any one time. If watering is to be worthwhile, it should put the soil in a moist condition to a depth of at least 2 inches. This can best be accomplished by the use of mechanical sprinkling nozzles that distribute the water as a gentle shower for at least one-half hour over a single area. A thorough watering will provide enough moisture for four to seven days. To lessen the danger of disease injury, watering should be completed by the middle of the afternoon. (For additional information on diseases, see p. 17.)

Although watering is usually needed some of the time during the summer if the lawn is to be maintained green, it does not necessarily injure grass to let it turn brown. Except under very severe conditions, the grass will green up to its normal condition as soon as there is sufficient rain.

Use of Aerifiers

In recent years aerifiers of one sort or another have appeared on the market. Their purpose is to open up small holes in the sod to facilitate aeration and penetration of water and fertilizer. The preferred types are those with hollow prongs which actually remove a column of soil, in contrast to the spike-type aerifiers which tend to compact the soil surrounding the hole.

Aerifiers are suggested for spring or fall use on old lawns which have developed a dense compact sod.

Fall Treatment

Fall is the best time to sample the soil for testing. Sampling instructions are given on p. 7. It is not necessary, however, to sample every year. Usually once in three or four years is sufficient under average conditions.

Repairing and Reseeding

In September all patches where the turf has been destroyed by weed invasion, diseases or pests should be spaded or the surface loosened deeply with an iron rake or aerifier and reseeded. Germination of the grass seed is likely to be higher if no fertilizer is applied at this time.

Thin turf, with no conspicuous bare spots, may be scratched deeply with an iron rake, all irregularities in the ground filled with screened loam, and seed scattered at about half the rate used for an initial seeding. Inasmuch as the poor condition of the lawn may be due to low fertility, a light application of fertilizer should be made and thoroughly watered in a few days before seeding.

Lime and Fertilizer

As stated previously, lime can be applied any time of the year. September fertilization is very helpful to the maintenance of a good lawn. A suggested treatment is 8 pounds per 1,000 square feet of an 8-6-4 or similar complete fertilizer, preferably one in which at least 30 per cent of the nitrogen is in organic form. The fully soluble fertilizers are less suitable for fall application.

Mowing

Fall mowing should be continued as long as the grass continues to grow. The former practice of leaving the grass long over winter is no longer considered a good method because long grass is more subject to matting which favors disease, poor aeration and winter kill.

Leaf Raking

A scattering of leaves does no harm but they should not be allowed to accumulate to smother the grass. Either rake off and, if possible, compost, or better yet, cut them up with one of the new leaf pulverizers, which leaves the fine product on the lawn as a mulch that does not smother the grass.

WEED CONTROL

A good stand of permanent grasses is the best control for weeds in the lawn. Since most lawn mixtures contain nurse or filler grasses such as redtop, ryegrass or timothy, holes may be left in the lawn as these grasses run out. When this occurs, immediate reseeding will help substantially in weed control.

Crabgrass

Crabgrass seed is present in most soils and is frequently brought into an uninfested lawn by top dressings of loam. Heavy infestations may arise in this manner. Crabgrass seed is not found in lawn mixtures.

The best control of crabgrass is to be had by taking advantage of its natural characteristics. The fact that crabgrass is an annual, i.e., it grows from seed each year and dies with the first frost in the fall, can be utilized in its control. Germination starts in May when hot weather begins and continues throughout the season, new plants appearing all through the summer. Therefore, if the seed is prevented from germinating, the lawn will have no crabgrass.

Crabgrass grows only in the sun. The key to its control is capitalizing on its inability to grow in the shade. Grass cut at a height of 2 inches helps to shade crabgrass seed. Bare or thin spots in a lawn permit crabgrass to get started and thrive. A carefully planned seeding and fertilizing program produces such a thick turf that crabgrass will be crowded out.

Chemical crabgrass killers such as phenyl mercuric acetate and potassium cyanate, when used according to the manufacturer's directions, may control this lawn pest. These chemicals destroy young crabgrass plants which have no more than four leaves. Older plants beyond the four-leaf stage are not readily killed. Use of crabgrass killers may burn some of the lawn grasses, especially the bents, and although these grasses frequently recover, the lawn may be unsightly for some time.

The building of a dense turf takes a long time, but in the end will achieve the best results. Where long-cut and well-nourished turf exists, crabgrass finds no home.

Dandelions, Wild Onions, Chickweed, Sheep Sorrel

Keeping the soil slightly acid may control such weeds as dandelions, wild onions and chickweed, but not sheep sorrel which grows over a wide range of soil acidity. The presence of sheep sorrel is not necessarily indicative of soil acidity, contrary to the popular belief.

Once these weeds are established they can be controlled by applications of 2,4-D. This is a selective herbicide which kills most broad-leaf plants but leaves grasses unharmed, except for the bents which may be slightly injured. 2,4-D is a growth hormone and for most effective use should be applied when the day is hot and the plants are growing rapidly. It is equally effective whether applied as a spray or dust. Isolated weedy spots can be treated by placing the dust form of 2,4-D in a large saltshaker and shaking it over the weeds to be eliminated. Application on a day *without wind* will help prevent drift that could injure or kill near-by ornamentals or vegetables. Because the ester formulations of 2,4-D are volatile in the sun and may cause injury days after application, it is more practical for the home owner to use the amine formulations.

2,4-D is reported to be non-inflammable and non-corrosive, and non-poisonous to warm-blooded animals (unless oil carriers are used, as in the ester formulation).

A separate sprayer for 2,4-D is necessary because sprayers used for 2,4-D application cannot be readily cleaned out so they are safe to use in applying pest-controlling sprays to flowers and crop plants. A minute amount of 2,4-D can cause a lot of damage when the sprayer is used for something else.

Variable success with the use of 2,4-D on dandelions has been reported: some tests indicate they grow back the following season; others that the dandelions are completely killed. 2,4-D may be used to rid the lawn of wild onions or garlic, common chickweed (Stellaria) and sheep sorrel.

The following lawn weeds are generally susceptible to 2,4-D.

Chickweed
Cinquefoil
Dandelion
Plantain

The following are moderately resistant to 2,4-D but may be killed by repeated treatments.

Buttercup
Cheeseweed
Chickweed
Honeysuckle
Knotweed
Sheep sorrel
Wild garlic
Wild onion

The following plants are more or less resistant to 2,4-D.

Crabgrass
Gout weed
Leafy spurge
Milkweed
Oxalis
Ox-eye daisy
Quackgrass
Violets
Wild strawberry
Yarrow

Weeds in Gravel Walks and Driveways

Borax sprinkled on the ground beside such weeds will kill them in time. This chemical is absorbed by the roots of the plants and kills slowly but very effectively. Common table salt or calcium chloride may be used in the same manner.

As these chemicals are toxic to all plants, care must be taken to see that none washes onto the lawn or flowers. Borax leaches into the soil, and any roots under the area of application will eventually take it up, so that trees with spreading root systems like maples, pines, or hemlocks may be injured in this way, even though the tree itself is 30 feet away.

Moss

Improvement of the soil is the only real cure for moss competition. The appearance of moss in a lawn does not necessarily mean the soil is acid, as is the popular belief, but rather indicates a lack of phosphates and potash. A soil analysis with accompanying recommendations will usually solve the problem. Moss may appear in sunny areas or in the shade, but reseeding after soil improvement will usually crowd it out.

Algae

Algae, the green slime found in damp shady areas of a lawn, is often referred to as "moss". It is really a fresh water plant and may be eliminated by spraying with 1 teaspoon of copper sulfate in 8 gallons of water, but the algae will return unless the causal condition is corrected. Admitting light to the area, improving the condition of the soil, particularly its drainage, and reseeding will push out the algae.

Mushrooms and Toadstools

Mushrooms, commonly called toadstools, appear in lawns during periods of high humidity or prolonged rainfall, especially where the soil is high in organic matter. They are often found around old stumps or where stumps have been. They have chiefly a nuisance value but in some instances there may be harmful species present. There is no spray that will kill the part of the fungus that produces the toadstools. The toadstools may be removed by rake or by hand. If there is a question that they are poisonous, they may be put into a paper bag and burned.

INJURIES AND DISEASES

There are a few fungus diseases which may cause injury to lawns, but injury from other causes is often mistaken for the symptoms of disease. The most common injury, often not recognized as such, is sunburn. This occurs after a few hot days following wet, cool weather. Since the various kinds of grass are burned differently, the injury often simulates definite areas of diseased grass. Sunburn obviously does not occur under trees.

Drought injury is a closely related trouble which is usually more widespread and occurs after prolonged dry spells. This injury shows first on thin soils exposed to full sun; later, shaded areas show injury. Heavy watering at the first signs of drought injury will forestall most of the trouble. If the grass has turned brown, it will recover very slowly until cool fall weather.

Putting rugs or rubber mats on the grass on a hot day will burn the grass. In this case the burned area will conform to the shape of the object and diagnosis is easy. Burning of grass with chemical fertilizers has already been mentioned. Female dogs frequently cause circular dead areas on the lawn. Such areas later show a ring of dark green grass around the dead area.

Brown Patch

Brown patch has shown a marked increase in occurrence in recent years. It may be recognized by just what its name implies: a brown patch that may or may not increase in size, the grass being pale tan and in the final stage completely dead.

The fungus that causes it is *Rhizoctonia solani,* which acts by infecting and rotting the roots and crown of the plant. This disease can be controlled by a solution of oxyquinoline sulfate watered on the soil: the rate of application is 1 level teaspoon of oxyquinoline sulfate in 3 gallons of water, with 1 pint of solution to a square foot. Dead plants will not be revived but partly infected plants may recover. Application is usually necessary only once a year, and one application may last two years. In rare cases, more than one application is necessary during one growing season.

Lawn Rot

Lawns most likely to be attacked by this disease are those that are watered frequently or continuously, particularly late in the day. The disease appears during warm humid weather and produces a sudden rotting of the grass in irregular spots. These spots have a characteristic dark, water-soaked appearance quite unlike any other type of injury and usually appear in areas fully exposed to the sun. The grass will recover from a light attack if dry weather follows, but continued humid weather allows the fungus to completely kill the grass. This disease is difficult to control. Two or three Bordeaux or Tersan sprays timed a week apart will help to check the spread. On new seedings treatments are more effective if started in late May or early June before the disease appears. Newly seeded areas kept as dry as the weather will permit are less likely to be attacked. Watering the lawn in the morning permits the grass to dry quickly and helps prevent the spread of this disease.

Snow Mold

Snow mold is a fungus disease which develops under snow cover during the winter and appears as white spots on the lawn in the spring. Applications of fertilizer after September 15 produce a luxuriant growth of grass late in the season and may predispose the lawn to infection by the snow mold fungus. Ordinarily this disease causes only temporary

damage which disappears when growth begins in the spring, and control measures are not necessary. If a lawn is consistently attacked, treatment with a turf fungicide in late fall may reduce the severity of injury.

Copper Spot, Dollar Spot

These diseases are occasionally found on lawns but are of very minor importance. Copper spot appears as small circular copper-colored spots which are most conspicuous right after the lawn is mowed. The causal fungus is present only near the soil level, and the symptoms can be seen only when the grass has been cut. Dollar spot makes white spots about the size of a silver dollar. This disease rarely occurs in the home lawn. Neither disease is of sufficient importance to warrant control measures.

Slime Molds

Frequently during wet weather patches of a bluish gray or black mold appear on the grass in the lawn. Another of these molds may appear as large masses of yellowish growth. Neither of these organisms is parasitic on the grass and can do no harm except perhaps smother the grass in small areas. If necessary, the unsightly masses can be swept off with a broom and the spot heavily dusted with sulfur or sprayed with Bordeaux mixture. Usually both organisms disappear with the advent of dry weather.

Salt Water Injury

Salt water injury is becoming an increasingly common occurrence along the shore. Even the spray is injurious. Damage to lawns can be prevented where the exposure to salt water has been of short duration by hosing off with fresh water as soon as the sea water subsides. However, if the grass has been submerged as long as six hours or more, hosing may or may not be of benefit.

Where reseeding is necessary, it will not be successful unless at least two inches of rain have fallen or an equivalent amount of water has been applied by sprinkling to wash out the salts from the soil. This leaching is quite effective on the sandy, friable soils which characterize most of the Connecticut shoreline. On fine textured soils, removal of sea water salts may be facilitated by the application of gypsum at the rate of about 100 pounds per 1,000 square feet. There is no chemical that will get rid of the salts quickly.

INSECT PESTS

Although there are many insect pests of grasses, native grasses growing under natural conditions are not seriously attacked. However, with the introduction and improvement of grasses under cultivation, where one or more varieties grow intimately together, destructive insects and other troubles may increase. Experiments carried on during the past decade have demonstrated that insecticides will control insect pests in lawns. A discussion of some of the materials is given in the following pages, supplemented by a table concerning their use.

Japanese and Asiatic Garden Beetle Grubs

Lawns are often infested with white grubs, the most common of which is the larva of the Japanese beetle. Japanese beetle grubs feed on grass roots during most of the spring and summer months until the weather grows cool in the fall. Injury is most noticeable in May and early June. The first sign of injury is a yellowing of the grasses; if grub feeding continues unchecked, the lawn will later appear straw-colored. A sure sign that beetle grubs are feeding in the lawn is loose turf, caused by destruction of the grass roots. Portions of the turf may be easily removed by scuffing or hand pulling. When grubs are numerous, the lawn may be destroyed completely unless control steps are taken.

Which Insecticide Should Be Used?

Four insecticides have given superior control of grubs of the Japanese beetle, Asiatic beetle, June beetle and other related species in our experiments. These are chlordane, DDT, methoxychlor and dieldrin. Each has its advantages in certain situations. When a quick kill is desired, chlordane may be used. Chlordane, besides being quick-acting, is known to give protection for at least six years. Methoxychlor is slower acting than DDT, chlordane or dieldrin for grub control in lawns; however, it is less hazardous to handle than these compounds and much less injurious to mammals and birds. Methoxychlor will give protection for about three years.

Method of Application

Any of these insecticides may be used in either dust or liquid form. If used as a dust, the insecticide may be mixed with fertilizer to increase bulk of solids and thereby provide a more even and thorough distribution. A hand-operated fertilizer distributor is a convenient means of application. DDT, chlordane, methoxychlor or dieldrin should not be applied with lime nor used in the same season that lime is applied to the lawn.

In liquid form, the insecticide may be applied with a hand-operated, mechanical pressure sprayer. A watering can may be used for small scale applications. In all cases, the spray mixtures must be kept agitated to prevent settling of the insecticide.

The insecticides discussed may be applied to lawns at any time when the ground is not frozen. Early spring treatments are preferable, however, because they destroy the over-wintering grub population before the grubs start feeding. Second choice in application date is late August or early September which will give desired control before hibernation. Treatments will give fastest results if timed to precede a rain storm or if artificial watering is used immediately afterward to wash the material into the soil. This washing also protects children and household pets from the chemical. Summer or fall, rather than spring treatments, are less apt to be injurious to migratory song birds and native species. Chlordane and DDT are poisonous to some degree. Rates of application are given in Table 4.

Chinch Bug

Chinch bug injury may appear in lawns from mid-June until early fall. Early in the summer injured lawns have dead brown areas of irregular size and shape which grow larger and more abundant as the season advances. By autumn most of the grass may have been destroyed, leaving only crabgrass, weeds and clover. Chinch bugs are most injurious in bent, young blue grass, and fescue lawns. Warm, dry weather favors the spread of this insect while wet weather in early summer when young chinch bugs are developing reduces the population materially.

The presence of the insect may be detected by examining the grass at frequent intervals at or close to the surface of the ground. The small (1/5 to 1/6 inch in length) black, fast-moving adults with white wings will be seen scurrying about in an effort to conceal themselves. The smaller brick-red immature stages may be seen also in great abundance wherever the infestation is serious.

Control

Chinch bugs may be controlled by either chlordane, dieldrin, or DDT applied in dust form. As in Japanese beetle treatments, chlordane will give a faster kill than dieldrin or DDT, but the residual protection afforded by a dieldrin or DDT treatment is longer. The insecticide may be applied with fertilizer as described on page 20. Rates of application are given in Table 4. When the insecticide treatment is accompanied by fertilizing and watering, early recovery of the grass can be expected. Chlordane, dieldrin, and DDT-treated lawns rapidly regain a vigorous growth of deep green grass. Where large patches of grass have been killed completely by chinch bugs, reseeding may be necessary.

Sod Webworm

Lawns composed of bent grasses or young blue grass are most seriously injured by sod webworms. Irregular brownish areas appear in turf where this insect is feeding. On close examination the grass near the irregular dead areas will be seen to be short and of an uneven height. When an outbreak is serious, the lawn may acquire a moth-eaten appearance.

Adult moths of the webworms are dirty gray to yellowish brown in color. They remain more or less concealed during most of the day, coming out in late afternoon and evening.

Larval webworms chew off the blades of grass at the base, consuming them as they progress or drawing them into their tunnels to be eaten later. There are two to three generations a year, occurring from May through September 1. Since each generation may need to be controlled as it appears, no permanent insecticide treatment can be made which will assure seasonal protection.

Control

Experiments at this Station have shown chlordane to be an efficient insecticide for control of this insect. A high mortality may be expected within 24 hours after treatment.

Lead arsenate has been used extensively for the control of sod webworms and gives fairly effective protection. However, when used several times a year for a few seasons, this treatment frequently creates a serious residue problem in the soil.

For best results, the insecticide chosen should be applied in the late afternoon or early evening, when the webworms are feeding. Rates of application are given in Table 4.

Cutworms

There are several species of cutworms that cause lawn injury. Most species are smooth, greenish, brownish or dirty white grubs with or without striping on the body.

Presence of the feeding larvae may be suspected if adult moths have been seen in the area. The moths are of medium size with a wingspread of from one to two inches. They are usually multi-colored of dull hues such as brown, blackish, gray or dirty white.

Cutworms are among the earliest insects to begin feeding in the spring. Most species have but one generation a year, although occasionally there are two. Generations usually overlap, so that moths appear throughout the summer.

Cutworms injure grass by cutting off the blades at the base leaving small, elongated, or irregular closely cropped brown spots in the turf. In general, the larvae remain concealed just below the surface of the ground or in clumps of grass during the day, coming out at night to feed.

Control

Chlordane, dieldrin, DDT, or lead arsenate will give effective control of cutworms, although lead arsenate has the disadvantage of causing possible injury to grass with repeated treatments.

Any insecticidal treatment for this insect should be applied late in the afternoon to effect control during the night and the early hours of the following day. Sprays are preferred because they adhere well and can be uniformly distributed. Rates of application are given in Table 4.

Cutworm control on a small scale has been successfully accomplished by flooding the lawn with water until the soil is puddled. This treatment brings the cutworms to the surface where they may be collected and destroyed. Poison baits have been used extensively in the past with some degree of success. Such baits contain sodium fluosilicate, sodium arsenite, Paris green, or white arsenic. There is always the danger of animals and birds eating the bait unless it is well protected. This may be done by placing the bait under a shingle.

Ants

The cornfield ant is encountered in lawns more often than all other species and may be an annual problem for the homeowner. This is a little brown ant which builds small single or clustered anthills or craters

in open soil and on the surface of the lawn directly above its nest. Construction of the mounds usually occurs at night but may take place at any time of day. Moreover, no matter how frequently a crater may be destroyed, it will be rebuilt, providing the colony has not suffered a permanent injury.

Control

In tests at this Station, chlordane has given efficient and dependable control of the cornfield ant, as well as other ant species that occur in lawns. It gives a quick kill and residual protection for several weeks.

Two methods of treatment with chlordane are suggested. Where nests occur infrequently or at least not in great abundance, the individual anthills may be treated separately. Chlordane wettable powder may be applied to the center of each anthill, followed by thorough watering to force the material into the galleries of the nests. A small portable pressure sprayer with the spreader removed from the nozzle may be used for this purpose. Water slowly poured from a watering can with the sprinkler removed may be used if a pressure sprayer is not available. An alternative method is to add 1 ounce of chlordane wettable powder to a gallon of water and pour a small amount of the suspension into each nest. Treated areas of the lawn should be thoroughly drenched with water after the insecticide application to assure maximum penetration of the toxicant to the heart of the ant colonies.

Occasionally lawns are actually pock-marked with anthills. In this case chlordane should be applied in water suspension under pressure to the entire lawn. A hose and garden nozzle, the latter open as wide as possible, may be used for the purpose. Pressure at the spray tank pump should be maintained at about 100 pounds. Following treatment, the turf should be watered with 50 gallons of clear water to 1,000 square feet. If an occasional ant colony reappears after this complete application, it may be eliminated by the spot treatment method. Small hand pressure sprayer or watering can treatments are not efficient nor economical. Such treatment should not be undertaken unless mechanical spray equipment cannot be obtained.

Chlordane emulsion is equally efficient for control of ants. The insecticide may also be used as a dust. However, due to lack of quick penetration to the heart of the ant colonies, the efficiency of the dust treatment is not as great as that of the wettable powders and emulsions. For rates of application, see Table 4.

Leafhoppers

In certain years when the weather is dry and hot, especially during the latter part of the summer and early autumn, grass leafhoppers may cause serious injury to turf. There are several species involved, all of which discolor the grass by their feeding activities. Badly damaged lawns display an off-color from gray to a light brownish yellow. The presence of the insects may be detected before serious trouble arises by walking back and forth over the lawn on a warm, clear day. When present, the leafhoppers will hop or fly in all directions as the motion of one's feet scatters them.

As soon as their presence is detected, DDT treatment should be applied (see Table 4). Should reinfestation occur at a later date, the treatment must be repeated. One spray is seldom sufficient for the entire season.

Earthworms

Earthworms are beneficial soil-inhabiting animals. Their burrowing helps to keep the soil open and friable and passage of soil through their digestive tract increases its fertility. Rain penetrates soil more readily when it has been made porous by their activity.

In the home lawn or other specialized turf areas, especially where the fertility and moisture are high, certain disadvantages sometimes arise from the presence of an excessive earthworm population. An abundant population casting at least once in 24 hours will cause smothering of turf unless the castings are broken up and scattered or removed each day. Moreover, castings clog mowing machines and dull the cutting blades. Earthworms in newly seeded lawns kill young grass plants by uprooting them.

It may not be necessary and certainly is not desirable to eliminate an entire earthworm population from a lawn. Therefore, a control measure should be applied only where earthworms occur in excessive numbers and are troublesome. DDT applied as a dust or wettable powder will kill a large number of adult earthworms and virtually all of the young. After two or three months, however, the population may be back to normal status. Chlordane applied to excessive earthworm populations in the spring will destroy most of the earthworms present and prevent significant re-establishment for four or five months.

Moles and Other Burrowing Animals

Moles, field mice, skunks and other burrowing animals are frequently troublesome in lawns. Since they feed on grubs of the Japanese beetle and related species, control of these insects will deprive the animals of their food and discourage invasion. Poison baits have been used to control mice with some success. Should moles continue to recur in turf that has been treated with an insecticide, they may be effectively controlled by the use of a standard mole trap.

TABLE 4. COMMON LAWN INSECTS AND THEIR CONTROL

Insects	Preferred time of treatment	Materials[1]	Rate of application per 1,000 sq. ft.	Gallons of water used per 1,000 sq. ft.
Japanese and Asiatic beetle grubs	Early spring or late summer	DDT	6 lbs. 10% dust *or* 1-1/5 lbs. 50% W[2] *or* Emulsion — not less than ½ nor more than 2/3 lb. actual DDT in	.. 25 25
		Chlordane *or* Dieldrin[3]	5 lb. 5% dust *or* ½ lb. 50% W[2] *or* Emulsion-¼ lb. actual chlordane in	.. 25 25
		Methoxychlor	8 lbs. 10% dust *or* 1.5 lbs. 50% W[2]	.. 25
Native white grubs (June beetles)	Early spring or late summer	Chlordane *or* Dieldrin[3]	3 times the Japanese beetle rate	25
Chinch bug	When necessary in the summer	Chlordane *or* DDT *or* Dieldrin[3]	5 lb. 5% dust *or* 6 lbs. 10% dust	.. ..
Sod Webworms	When necessary	Chlordane	5 oz. 50% W[2]	4
		Lead arsenate	3 lbs.	20-50
Cutworms	When necessary	Chlordane	5 oz. 50% W[2] *or* 5 lb. 5% dust	2 ..
		DDT	6 lbs. 5% dust	..
		Lead arsenate	3 lbs.	25
Ants	When necessary	Chlordane	*Spot Treatment* ⅛ teaspoon of 50% W[2] per nest *Complete Treatment* 4 oz. 50% W[2] *or* Emulsion - not less than 2 oz. actual chlordane in *or* 10 lbs. 5% dust	... 75 75 ..

[1] Many of these insecticides are now available in granular form, which may be used as a substitute for dust formulations. The granular preparations spread easily, uniformly and accurately, and settle quickly on the ground without dust.
[2] Wettable powder.
[3] At 1/3 the chlordane rate.

TABLE 4. COMMON LAWN INSECTS AND THEIR CONTROL—(Continued)

Insects	Preferred time of treatment	Materials[1]	Rate of application per 1,000 sq. ft.	Gallons of water used per 1,000 sq. ft.
Leafhoppers	Usually mid-summer through Sept.	DDT	4 tablespoons 50% W[2]	5
Earthworms	When necessary	Lead arsenate	10 lbs. dust	. .
		DDT	1½ lbs. 50% W[2] *or* 5 lbs. 10% dust	10 . .
		Chlordane	20 lbs. 5% dust	. .
Moles, etc.		Trap Baits	Control of white grubs discourages moles, etc.	

[1] Many of these insecticides are now available in granular form, which may be used as a substitute for dust formulations. The granular preparations spread easily, uniformly and accurately, and settle quickly on the ground without dust.

[2] Wettable powder.

[3] At 1/3 the chlordane rate.

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